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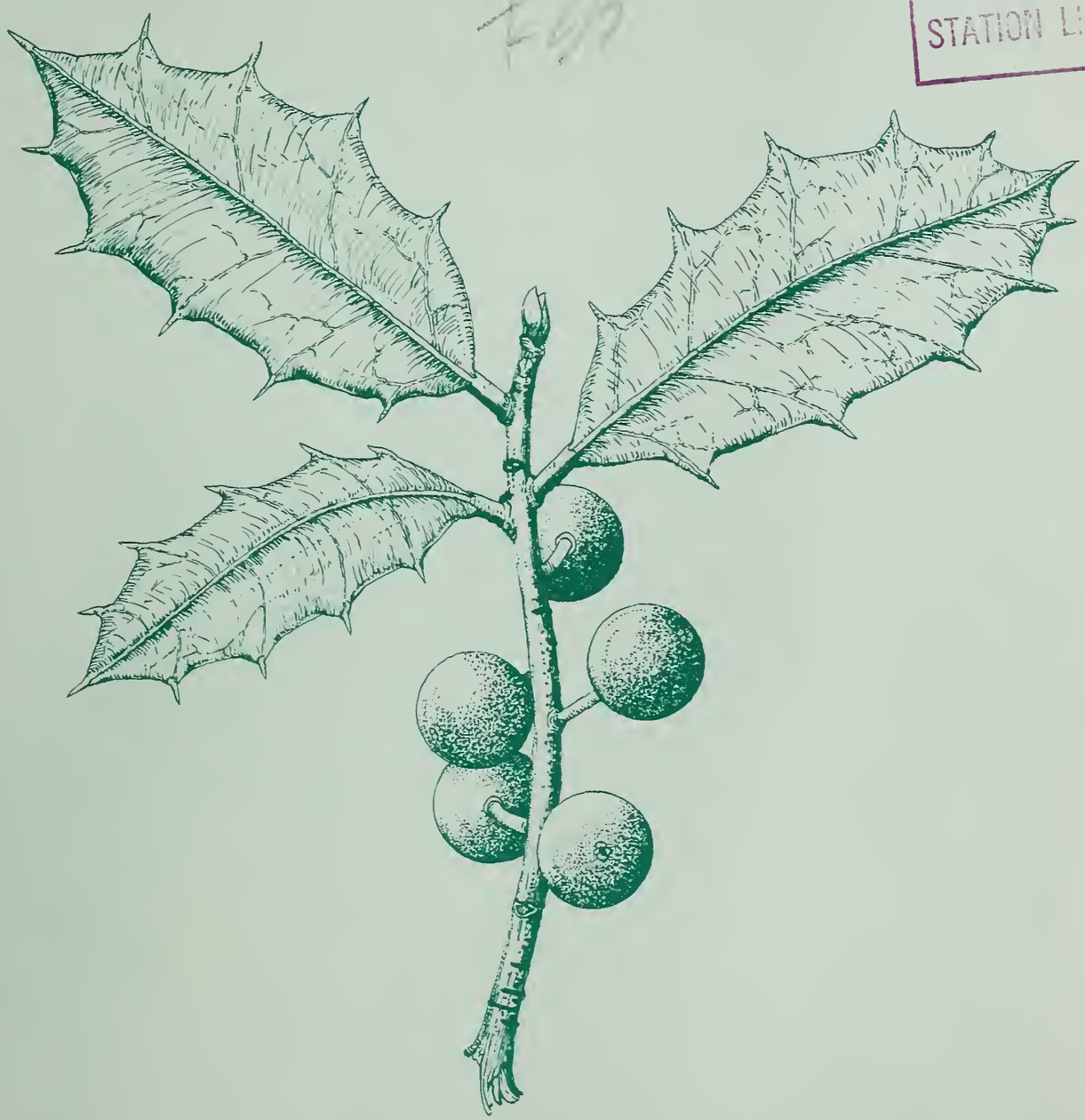

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SILVICAL CHARACTERISTICS OF AMERICAN HOLLY

(*Ilex opaca* Ait.)

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American holly, the largest of the native hollies, is probably one of the best known tree species in the United States. The Pilgrims found this tree in the open woods at Provincetown and Plymouth in 1620 *(26)*,[1] and its boughs, leaves, and berries are still a part of the Yuletide tradition for most American families. It is frequently used as an ornamental, yielding a most pleasant and pronounced effect all year. Many horticultural varieties with distinctive features have been propagated *(17)*.

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Figure 1.—Range of American holly.

American holly is known simply as holly in many places. It is also known as prickly holly or evergreen holly, and less frequently as white holly or boxwood *(4)*. The name holly was probably derived from its use during holy or religious celebrations *(13)*.

American holly is native from the coast of Massachusetts, where it is a shrub, to east Texas, where it reaches tree size. Its range is generally limited to the northwest by the Ohio River *(10)* and to the south by Mosquito Inlet and Charlotte Harbor, Fla. *(37)*. It is reported as far north as Indiana *(17)*, and although holly is typically a southern tree, during the last few centuries it has moved steadily northward until it now reaches altitudes of 600 feet above sea level in north-central Pennsylvania *(23)*. Its general range is shown in figure 1.

Although holly has wood of cabinet quality and good working characteristics, present supplies of merchantable sizes are limited and scattered so that the wood finds use only in specialty items. The wood is even textured, hard yet only medium heavy, of a light color which stains readily, and unexcelled for taking some types of finishes *(33)*.

SITE

Climate

American holly grows in a humid climate *(41)*. Mean annual precipitation ranges from 40 inches in the extremes of the range to 80 inches in the southern Appalachian Mountains. During the growing season 20 to 40 inches of rain fall. It is not uncommon for the northern part of the range to have 40 inches of snowfall per year, but snowfall is a rarity at the southern and western extremes *(25)*.

Mean annual temperature is 50° F. in the northern part of the range and 70° in the extreme southern part. The growing season

[1] Italic numbers in parentheses refer to Literature Cited, p. 6.

ranges from 160 days at the northern extreme to a very lengthy season with only occasional frost in west coast Florida *(25)*.

Soils and Physiography

American holly grows in a wide variety of soils. These include mountain top soils, almost pure sand near sea level, hammocks in swampland, and most types of soil conditions in between. Hollies are found most frequently on the neutral to slightly acid, well-drained, fairly light, loamy to sandy textured soils *(30)*. In the north, American holly generally grows in dry, rather gravelly sand, and often in the margins of oak woods *(36)*.

The largest trees are found on the rich bottom lands of eastern Texas and southern Arkansas *(10)*. In the bottom lands of the South, American holly grows principally in minor stream bottoms, but it grows also on high ridges of the oldest alluvium and in most hammocks *(35)* (fig. 2). Beaven and Oosting *(3)* include American holly on swampy upland borders in their study of the Pocomoke Swamp on the eastern shore of Maryland. They concluded that the evergreen, waxy-leafed shrub species occupy these sites with comparatively dry surfaces and fluctuating water table by default.

In general, holly seems to thrive best at elevations not more than 1,200 feet above sea level *(24)* although it is found at much higher elevations in the southern Appalachian Mountains.

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Figure 2.—Mature American holly tree from the Mississippi Delta in Arkansas. This female tree was about 50 feet in height and 15 inches in diameter.

Associated Trees and Shrubs

The Society of American Foresters *(40)* lists holly as the genus *Ilex* in a number of forest cover types, but does not refer specifically to American holly. The species is present in a high percentage of the cover types within its range, however, and its common associates vary widely. Examples of these associated species in five diverse locations are given in table 1, the associates at or near the extremes of the range representing disjunct communities.

Holly grows in pure stands in the South *(33)*, where little islands of it, although not common, sometimes occupy as much as 5 acres. Holly does not invade old-fields for some time following land abandonment. For example, Oosting *(32)* reports that holly made its first appearance in abandoned old-field loblolly pine stands in the Piedmont of North Carolina in 42-year-old stands and becomes more common in older stands.

Birds and Animals

American holly fruit is subject to heavy loss from migrating birds, especially robins. Yearround residents such as mockingbirds will likewise eat holly berries *(22)*. The fruit has been recovered from a large number of birds including bobwhite and wild turkey *(44)*.

Squirrels are among the mammals that eat the berries *(22)*, and white-tailed deer browse holly *(44)*.

American holly is insect pollinated, and honey bees are numerous and important visitors. Although not as well advertised in the trade as gallberry *(Ilex glabra)* honey, American holly yields fine table honey *(2)*.

LIFE HISTORY

Seeding Habits

Flowering and fruiting.—American holly is diodecious, i.e., the male and female flowers are borne on different plants. However, good pollination can be secured by budding or grafting staminate members into the top of a pistillate tree *(22)*.

Inflorescences are produced on the basal parts of new growth as they emerge after the dormant season. The small male greenish flowers form in clusters of 3 to 9; they bloom in midspring *(33)*. The fertile female flowers, which form from April to June, usually are solitary. Trees develop fruit at a very early

TABLE 1.—*Major associates of American holly in selected sections of its range*

Region	Associated species	Authority
New England coastal plain (Sandy Hook, N. J.)	red maple *(Acer rubrum)* eastern redcedar *(Juniperus virginiana)* black cherry *(Prunus serotina)* hackberry *(Celtis occidentalis)*	Chrysler *(8)*.
Georgia Piedmont (Walton Co., Ga.)	shortleaf pine *(Pinus echinata)* oaks *(Quercus* spp.) hickories *(Carya* spp.) sweetgum *(Liquidambar styraciflua)* blackgum *(Nyssa sylvatica)* yellow-poplar *(Liriodendron tulipifera)* white ash *(Fraxinus americana)* dogwood *(Cornus florida)*	Brender and Nelson *(7)*.
Southeastern Pennsylvania	yellow-poplar sweetgum willow oak *(Quercus phellos)* red maple white ash southern red oak *(Quercus falcata)* sweetbay *(Magnolia virginiana)* buttonbush *(Cephalanthus occidentalis)* fringetree *(Chionanthus virginicus)*	Grimm *(19)*.
Hill section of western Kentucky	eastern hemlock *(Tsuga canadensis)* eastern white pine *(Pinus strobus)* yellow birch *(Betula alleghaniensis)* American beech *(Fagus grandifolia)* white oak *(Quercus alba)* chestnut oak *(Quercus prinus)* shellbark hickory *(Carya laciniosa)*	Braun *(6)*.
Mississippi Delta	hickory spp. swamp chestnut oak *(Quercus michauxii)* white oak post oak *(Quercus stellata)* cherrybark oak *(Quercus falcata* var. *pagodaefolia)* water oak *(Quercus nigra)* white ash American elm *(Ulmus americana)* sweetgum	Putnam and Bull *(34)*.

age (fig. 3), but it takes 9 years or so before enough fruit is produced to harvest in any quantity *(15)*. Seeds are then produced for a hundred years or more *(24)*.

Good seed crops seem to appear annually. Fruiting of an individual tree, however, can be unpredictable; it may bear heavily one year and be barren the next. Late frosts can kill the blossoms in May, or heavy rains in early spring can prevent the spread of pollen *(16)*. There are approximately 20 to 27 pounds of seed per hundred pounds of fruit, each pound of seed containing about 25,000 seed *(43)*.

Seed dissemination.—American holly seed is principally disseminated by birds. This probably accounts for the spread, especially along the migratory flyways, of natural varieties such as the everbearing holly found originally at Gunston Hall, Va. *(39)*.

Vegetative Reproduction

Like many other hardwoods, American holly will sprout in natural stands. It does not sprout as readily as many species in the southern hardwood forests. The species can be propagated readily by most techniques *(11)* except root cuttings *(12)*. The preferred method of vegetative progagation is from stem cuttings. Wells *(45)* suggests taking the cuttings from late August to early October, treating them with indolebutyric acid, and growing them under high humidity with bottom heat.

Seedling Establishment and Development

Establishment.—Germination of holly seed is very slow; many seeds do not germinate until the second or third season *(11)*. Maisenhelder *(31)* concluded that American holly is readily established in the understory of the Delta bottom-land forests because of its tolerance of

shade, and that it may interfere with other reproduction as the overstory is removed.

Early growth.—Holly is not a fast growing tree. In natural stands, Tryon and Pease *(42)* predicted growth rates for natural holly under full sunlight, medium shade, and heavy shade when 16 years old (table 2).

In plantations, holly shows a somewhat higher rate of early growth. After 9 years of growth in eastern North Carolina, and with extensive cultural practices such as mowing, mulching, and fertilizing, 10-year-old American holly trees were from 20 to 24 feet high, 10 to 14 feet in crown spread, and heavily berried.

TABLE 2.—*Comparison of growth rates under three conditions of sunlight for natural stems of American holly at age 16 years*

Sunlight Class	Height	Crown area	Leaves
	Feet	*Square feet*	*Number*
Full sunlight	7.3	61.5	1,900
Shade:			
Medium	6.2	41.0	600
Heavy	5.3	26.5	300

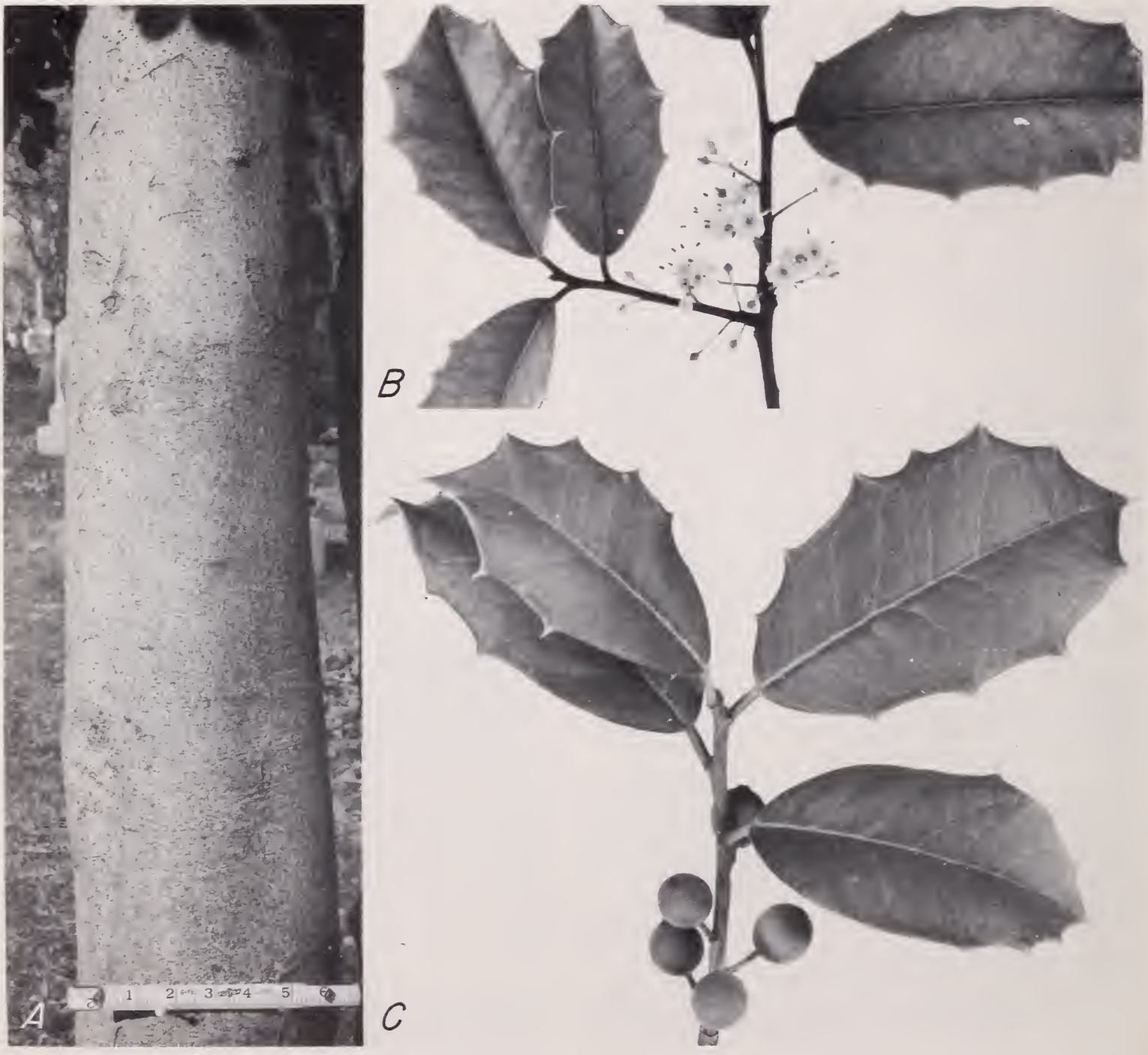

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Figure 3.—American holly: *A*, Typical bark; *B*, staminate flowers; *C*, fruit and leaves.

Sapling Stage to Maturity

Growth and yield.—Because American holly is not commonly included with sawtimber trees, its habits of growth have not been studied extensively. Chrysler *(8)* reported that on Sandy Hook, N.J., one holly reached 11.5 inches in diameter near its base in 77 years and another reached 13.0 inches in 96 years. Hume *(22)* records an American holly 25 inches in diameter at 4 feet above the ground; this tree was over 50 feet in height and over 300 years old. Gray reported an American holly in Pamlico County, N.C., with a circumference of 11 feet 1½ inches and a height of 72 feet *(1)*.

The volume growth of holly has been recorded sufficiently, however, to indicate that it is slower growing than most of its associates *(35)*. American holly reaches a diameter of 12 inches in about a century, but on many sites it may take 140 to 150 years *(22)*.

On the better sites of the Mississippi Delta, however, Betts *(4)* states that trees 2 to 3 feet in diameter are not uncommon and "such trees may be 100 years old." Also, Blake *(5)* indicates that under ideal conditions American holly will grow from 3 to 4 feet in height per year, but intensive cultural practices would ordinarily be necessary to reach this level.

The production of holly sprays is high. Trees 15 years old should produce about 20 pounds of berried holly sprays each year. An acre of well-tended holly orchard on a good site will produce as much as a ton of berried sprays and sprigs each year *(14)*.

Reaction to competition.—American holly is considered very tolerant of competition although competition will reduce its growth rate *(35)*. It is also very tolerant of wind and salt spray. Holly has survived after remaining under salt water for nearly 2 weeks following hurricanes *(5)*.

ENEMIES AND HAZARDS

Perhaps holly's most serious enemy in the United States has been man. Unwise and destructive harvesting have all but eliminated American holly from New England southward into central New Jersey, according to Dengler *(14)*. Fortunately, a number of States in the most populated areas have taken positive steps to promote proper harvesting methods and legislate against theft.

Holly is highly susceptible to fire, and stands containing holly should be protected. The green leaves burn almost as readily as dead ones, and the bark is easily injured by high temperatures. Even light fires often kill the whole holly tree, or at least a considerable part of the lower branches *(11)*. Three annual prescribed burns in a southern pine stand containing holly reduced foliage production of American holly and the number of plants producing fruit by approximately 95 percent *(28)*.

Holly is subject to twig and branch kill during extreme cold periods in winter or when coatings of ice remain on the foliage for some time following sleet storms.

Heavy winds, such as occur in hurricanes, cause the sharp spines of mature foliage to puncture other leaves. The spine punctures are unsightly and reduce the quality of foliage sold in the Christmas trade *(20)*.

Very few diseases are important hazards to growing holly *(18)*. More than 70 different fungi have been reported on American holly, but only one is important. During years of excessive rainfall, tar or black spot is produced by *Phacidium curtisii*. It materially reduces the value of the leaf and berry crop, sometimes making a large part of it unsalable. It can be controlled by spraying, coupled with sanitary measures *(9)*.

Less than 30 species of insects attacking American holly have been recorded, and a very limited number of these are serious pests. Fortunately, good control methods have been worked out for them *(20)*.

The southern red mite, *Oligonychus ilicis,* is a serious pest, causing a reduction in leaf and twig growth and undesirable foliage color.

Several species of scale insects attack American holly. The walnut scale *(Aspidiotus juglans-regiae)*, the oleander scale *(Aspidiotus hederae)*, and the rhododendron scale *(Aspidiotus pseudospinosus)* have been reported as present, but not too injurious *(20)*. In addition, Hamilton reports that an unidentified species of *Aspidiotus* has been one of the most injurious of the scale insects. In heavy infestations, the cambium layer turns black and the leaves turn brown and die.

Other scale insects reported on American holly include the holly pitmaking scale *(Asterolecanium puteanum)* and the European fruit lecanium *(Lecanium corni)*. Leaf miners are among the worst pests of holly and can damage the plants severely. Heavily infested leaves drop from the tree in the fall. The most common species attacking holly is the European holly leaf miner *(Phytomyza ilicis)*. The next most common species is the American holly leaf miner *(Phytomyza ilicicola)*, a native insect *(22)*. Currently, there is some confusion concerning the relative importance of these two species of holly leaf miners.

The holly midge *(Asphondylia ilicicola)* is limited in its range from Maryland southward; it causes the berries to remain green instead of

ripening to the desirable red or orange shades. An ambrosia beetle *(Xylosandrus germanus)* invades the wood of branches or the main stem and is injurious.

Spittlebug injury by *Monecphora bicincta* has been frequently noted in the South. Leaves may be killed and drop off or, if they survive, are discolored, distorted, and stunted *(22)*.

RACES AND HYBRIDS

The primary basic chromosome number of the genus *Ilex* is 9 or 10. American holly belongs to the group of hollies that possess 36 chromosomes *(27)*.

Two races of American holly are recognized. The typical American holly, *Ilex opaca* Ait., is distinguished from dune holly, *Ilex opaca* var. *arenicola* (Ashe) Ashe, by Little *(29)*. The latter, a miniature of American holly, is found only on the scrubs of central Florida. It reached a height of 15 feet, has small leaves and large fruit, and is confined to a xerophytic habitat *(46)*.

An attempt has been made to separate a variety *subintegra* based on a paucity of spines on the leaf and a variety *xanthocarpa* based on yellow-fruited specimens, but several authorities believe that it would be ill advised to separate taxonomic forms of American holly on the basis of leaf form or fruit color *(22)*.

Natural hybrids of American and dahoon holly are recognized, i.e., *Ilex* × *attenuata (I. cassine* × *opaca) (29)*. The intergraded hybrids are usually less spiny leafed and less hardy, perhaps as a result of their dahoon parentage *(17)*. Hume *(22)* further reports that *I. opaca* pollen is effective on female dune holly *(I. opaca* var. *arenicola)* but not on *I. rotunda*, an Oriental species.

Kosar *(27)* also reports interspecific crosses between the myrtle dahoon (*Ilex myrtifolia*) and American holly. Skinner *(38)* has reported additional crosses of *I. opaca* with *I. aquifolium* and with *I. aquipernyi*.

In addition, the Holly Society of America has established varietal certification for clones of vegetatively propagated hollies. Approximately 270 clones of which nearly 40 were male have been listed by the group *(21)*.

LITERATURE CITED

(1) Anonymous.
1955. These are the champs. Amer. Forests 61(9): 31–40.

(2) Abrams, George J.
1940. It's the berries; commercial holly pollination—a possible new role for the honeybee. Amer. Bee Jour. 80: 11–12, 28.

(3) Beaven, George Francis, and Oosting, Henry J.
1939. Pocomoke Swamp; a study of a cypress swamp on the eastern shore of Maryland. Torrey Bot. Club Bul. 66: 367–389.

(4) Betts, H. S.
1953. American holly. U.S. Forest Serv. Amer. Woods Series. 4 pp.

(5) Blake, F.
1959. American holly on Cape Cod. Amer. Forests 65(12): 15, 36–37.

(6) Braun, E. Lucy.
1950. Deciduous forests of eastern North America. 596 pp. Philadelphia and Toronto: The Blakiston Co.

(7) Brender, E. V., and Nelson, T. C.
1954. Behavior and control of understory hardwoods after clear cutting a Piedmont pine stand. U.S. Forest Serv. Southeast. Forest Expt. Sta., Sta. Paper 44, 17 pp.

(8) Chrysler, M. A.
1930. The origin and development of the vegetation of Sandy Hook. Torrey Bot. Club Bul. 57: 163–176.

(9) Cole, John R.
1951. Control of tarspot of holly *(Ilex)* by spraying in south Georgia. U.S. Dept. Agr. Plant Dis. Rptr. 35: 408–410.

(10) Collingwood, G. H., and Brush, Warren D.
1955. Knowing your trees. 328 pp. Washington, D. C.: Amer. Forestry Assoc.

(11) Coville, Perkins.
1932. Growing Christmas holly on the farm. U.S. Dept. Agr. Farmer's Bul. 1693. 22 pp.

(12) Creech, John L.
1957. Minor methods. Natl. Hort. Mag. 36(1): 119–121.

(13) Dengler, Harry William.
1957. Folklore and legends. Natl. Hort. Mag. 36(1): 1–7.

(14) ———
[n. d.] Growing Christmas holly. Md. Univ. Ext. Serv., 9 pp., [mimeo.]

(15) Fenton, Daniel G.
1957. Orcharding in the middle Atlantic area. Natl. Hort. Mag. 36(1): 167–170.

(16) Fritz, Nelson H.
1950. Harvest time for holly. Amer. Forests 56(12): 20–21, 44–45.

(17) Galle, Fred C.
1957. North American hollies. Natl. Hort. Mag. 36(1): 11–31.

(18) Gravatt, G. Flippo.
1957. Diseases of holly in the East. Natl. Hort. Mag. 36(1): 107.

(19) Grimm, William Carey.
1950. The trees of Pennsylvania. 363 pp. New York and Harrisburg: Stackpole and Heck, Inc.

(20) Hamilton, Clyde C.
1957. Holly pests in the East. Natl. Hort. Mag. 36(1): 91–102.

(21) Holly Society of America.
1953. Preliminary holly check list. Holly Soc. Amer. Bul. 6, 56 pp.

(22) Hume, H. Harold.
1953. Hollies. 242 pp. New York: The Macmillan Co.

(23) Illick, Joseph S.
1924. Tree habits: How to know the hardwoods. 337 pp. Washington, D.C.: Amer. Nature Assoc.

(24) Jackson, J.
1941. Blitzkrieg on holly. Amer. Forests 47: 568–569.

(25) Kincer,
1941. Blitzkrieg on holly. Amer. Forests 47: 568-569.

(26) Knowlton, Clarence H.
1914. New England distribution of *Ilex opaca* and *Ilex glabra*. Rhodora 16: 163–165.

(27) Kosar, Wm. F.
1957. Hybridizing hollies. Natl. Hort. Mag. 36(1): 121–129.

(28) Lay, Daniel W.
1956. Effects of prescribed burning on forage and mast production in southern pine forests. Jour. Forestry 54: 582–584.

(29) Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dept. Agr. Handb. 41. 472 pp.

(30) McLean, Stewart H.
1957. Planting hollies. Natl. Hort. Mag. 36(1): 86–88.

(31) Maisenhelder, Louis C.
1958. Understory plants of bottomland forests. U.S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 165, 40 pp.

(32) Oosting, Henry J.
1942. An ecological analysis of plant communities of Piedmont, North Carolina. Amer. Midland Nat. 28: 1–126.

(33) Peattie, Donald Culross.
1950. A natural history of trees of eastern and central North America. 606 pp. Boston: Houghton Mifflin Co.

(34) Putnam, J. A., and Bull, Henry.
1932. The trees of the bottomlands of the Mississippi River Delta Region. U.S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 27, 207 pp.

(35) ———, Furnival, George M., and McKnight, J. S.
1960. Management and inventory of southern hardwoods. U.S. Dept. Agr., Agr. Handb. 181, 102 pp.

(36) Sargent, Charles Sprague.
1892. The silva of North America. v. I, 119 pp. Boston and New York: Houghton Mifflin and Co.

(37) ———
1922. Manual of the trees of North America, 2d ed. 910 pp. Boston and New York: Houghton Mifflin Co.

(38) Skinner, Henry T.
1952. Holly breeding. Holly Soc. at Morris Arboretum Proc., Nov. 13-14, 1952, pp. 14–20.

(39) Smith, Wyman S.
1942. Discovered—an everbearing holly. Amer. Forests 48: 550–551.

(40) Society of American Foresters.
1954. Forest cover types of North America (exclusive of Mexico). Soc. Amer. Foresters. 67 pp.

(41) Thornthwaite, C. W.
1941. Atlas of the climatic types in the United States. 1900-1939. U.S. Dept. Agr. Misc. Pub. 421, 7 pp. 96 plates.

(42) Tryon, E. H., and Pease, R. W.
1953. Shading effects of natural canopies on holly characteristics. Castenea 18: 70–83.

(43) U.S. Department of Agriculture, Forest Service.
1948. Woody-plant seed manual. U.S. Dept. Agr. Misc. Pub. 654, 416 pp.

(44) Van Dersal, William R.
1938. Native woody plants of the United States; their erosion-control and wildlife values. U.S. Dept. Agr. Misc. Pub. 303, 362 pp.

(45) Wells, James W.
1957. A propagation program for hollies. Seventh Plant Prop. Soc. Ann. Mtg. Proc., pp. 92–98.

(46) West, Erdman, and Arnold, Lillian E.
1946. The native trees of Florida. 212 pp. Gainesville, Fla.: Univ. of Florida Press.